whence $\frac{du}{dx}=\frac{1}{2\sqrt{x}}$, $\frac{du}{dy}=\frac{1}{2\sqrt{y}}$, $\frac{du}{dx}=\frac{1}{2\sqrt{z}}$ ....(3).

Also, $X=Y=0$, $Z=-g=P$....(4).

Substituting in (1) and reducing, $z=\frac{2xy}{x+y}$....(5).

II. Solution by ALFRED HUME, C. E., D. Sc., Professor of Mathematics, University of Mississippi.

If W is the weight of the particle, N and T its normal and tangential components,

$$W^2=N^2+T^2.$$

Also, when the particle is on the point of sliding,

$$T=\sqrt{2}\,N.$$

Hence $W^2=3N^2$.

Again $W\cos\theta=N$, θ being the angle between the normal and the Z-axis.

Now $\cos\theta=\dfrac{\dfrac{dF}{dz}}{\sqrt{\left(\dfrac{dF}{dx}\right)^2+\left(\dfrac{dF}{dy}\right)^2+\left(\dfrac{dF}{dz}\right)^2}}$, $F(x, y, z)=0$ being the equation of the surface, and the differential-coefficients being partial.

$\frac{dF}{dx}=\frac{1}{2\sqrt{x}}$, $\frac{dF}{dy}=\frac{1}{2\sqrt{y}}$, $\frac{dF}{dz}=\frac{1}{2\sqrt{z}}$;

and, therefore, $\cos\theta=\dfrac{\dfrac{1}{\sqrt{z}}}{\sqrt{\dfrac{1}{x}+\dfrac{1}{y}+\dfrac{1}{z}}}$.

But $W^2\cos^2\theta=N^2=\frac{W^2}{3}$, from which $3\cos^2\theta=1$.

Substituting, $\frac{3}{z}=\frac{1}{x}+\frac{1}{y}+\frac{1}{z}$, or $\frac{2}{z}=\frac{1}{x}+\frac{1}{y}$, and z is a harmonical mean between x and y.

Solutions of this problem were also received from *F. P. MATZ* and *G. B. M. ZERR*.

24. Proposed by J. F. W. SCHEFFER, A. M., Hagerstown, Maryland.

A sphere whose center of gravity does not coincide with its geometrical center is placed on a rough inclined plane. State under what circumstances the sphere will slide without rolling, roll without sliding, and neither roll nor slide.

Solution by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics, Irving College, Mechanicsburg, Pennsylvania.

On a horizontal plane, the sphere will neither roll nor slide; but it will *rock* about the vertical drawn through the point of support. Down an inclined plane, the sphere will roll without sliding, until the *initial horizontal plane* through which the centroid has (by the rolling) become a *vertical* plane. So

long as this initial horizontal plane remains a vertical plane, the sphere will slide without rolling.

25. **Proposed by Professor GEORGE LILLEY, LL. D., Ex-President of Washington State Agricultural College and School of Science, Portland, Oregon.**

It is known that if the velocity of a certain freight train is 30 miles an hour it can be brought to a stand still in a distance of 500 feet by setting the brakes. It was stopped in 1200 feet by setting the brakes. Find its velocity, the forces exerted by the brakes being the same in each case.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Physics, Inter State College, Texarkana, Texas, and the PROPOSER.

$\frac{1}{2}Mv^2=Rs$, where M=mass, v=velocity, R=resistance of brakes, s=distance train runs after setting brakes.

30 miles per hour=44 feet per second.

$\therefore \frac{1}{2}M(44)^2=500R....(1)$. $\frac{1}{2}Mv^2=1200R....(2)$.

$$(2)\div(1),\quad \left(\frac{v}{44}\right)^2=\frac{12}{5}.\quad \therefore 5v^2=12(44)^2.$$

$\therefore v=88\sqrt{\frac{3}{5}}$ feet per second $=60\sqrt{\frac{3}{5}}$ $=46.4758$ miles per hour.

Also solved by *F. P. MATZ* and *E. W. MORRELL.*

PROBLEMS.

31. **Proposed by O. W. ANTHONY, Mexico, Mo.**

A perfectly elastic but perfectly rough sphere of mass M and radius R, rotating in a vertical plane with an angular velocity of ω, is let fall from a height, a, upon a perfectly elastic but perfectly rough horizontal plane. Determine the motion of the body after striking the plane. What will be its ultimate motion?

32. **Proposed by OTTO CLAYTON, A. B., Fowler, Indiana.**

The wheel of a wind pump has 60 fans, each turned at an angle 45° to the direction of the axis, and each having 150 square inches exposed to the wind. If the wind blows with velocity V and the wheel rotates with velocity ω what is the component of force or pressure along the axis if it is turned at an angle α to the direction of the wind assuming the resistance the wheel meets in turning to be R?

DIOPHANTINE ANALYSIS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

25. **Proposed by M. A. GRUBER, A. M., War Department, Washington, D. C.**

Find, if possible, integral values of each of the seven linear measurments of a